Japanese Laid-Open Patent Application No. 2002-335186

[0091]
(Sixth embodiment of the present invention) Fig.29 shows a mobile wireless communication apparatus in accordance with the sixth embodiment of the present invention. Like aforementioned embodiments of the present invention, the mobile wireless communication apparatus has an antenna 1, a wireless transceiver device 2, a signal processing device 3, a resource controller 4, and a storage device 5. In fig. 29, a system controller 6 and an input/output device unit 7 shown in Fig. 1 are omitted.

[0092]
A signal processing device 3 is configured as a processor, such as a CPU or a DSP, which performs software-like signal processing, or a programmable hardware device such as PLD. In the case where the signal processing device 3 is adopted as the processor, the processor has a storage area such as RAM area, into which an execution program is read, and performs a signal processing by loading a module group which includes a program for performing signal processing to the storage area. Modules, describes here, are compiled execution format files, in which each signal processing function is software-/modular-specific.

[0093]
Programs and data files are stored in the storage device 5. Particularly, these programs include module groups, which are intended for specification of the signal processing device 3. This allows the mobile wireless communication apparatus to read out a module group necessary for changing into another mode such as a reception mode for another channel from the storage device 5, and transfer it to the signal processing device 3.

[0094]
Fig. 30 shows the example of the storage area of the signal processing device 3 as well as the configuration of the storage device 5. The

signal processing device 3 has a DSP 210 as a processor, and a sound sending module 211 and sound receiving module 212 are read into its storage area. A data sending module 221, an equalizer module 222, a Viterbi decoder module 223 and a CRC module 224 are stored in the storage device 5.

[0095]
A resource controller 4 includes a resource management table 200, a resource manager 201, a resource rewriting processor 202 and download buffer 203. The information of the storage location of the module executable in the signal processing device 3 is memorized in the resource management table 200. The resource manager 201 controls (a) the order of changing the resources, (b) the decision as to whether the resources are changed and (c) the timing for the change. The resource rewriting processor 202 rewrites modules for the processor of the signal processing device 3, which is stored in the storage device 5, complying with a command from the resource manager 201. Modules downloaded from outside the system are temporarily stored in the download buffer 203.

[0096]
The basic operation of the mobile wireless communication apparatus which is according to this embodiment of the present invention is similar to the operation as described in the previous embodiments. Operations unique to this embodiment are described below. For example, if the shadowing, the condition in which the mobile wireless communication apparatus is shadowed by other objects, and other effects cause the deterioration of the transmission channel between the mobile wireless communication apparatus and the base station, which is not indicated in figures of the present invention, and thus if the desired communication quality cannot be achieved, the communication quality is detected by an electrolytic determination function of devices such as the wireless transceiver device 2.

[0097]
If the desired communication quality cannot be achieved, the resource

controller 4 decides that another equalizer needs to be incorporated into the resource of the signal processing device 3 in order to upgrade the quality. Based on this decision, the resource manager 201 performs the control by incorporating an equalizer module into the resource in the resource controller 4, when there is a margin in the resource of the signal processing device 3. The resource manger 201 confirms if there is any equalizer module in the storage device 5 by referring to the resource management table 200.

[0098]
As described in Fig. 30, if there is an equalizer module 222 in the storage device 5, the resource controller 4 reads it into the signal processing device 3 as an execution file for a processor serving as the signal processing device 3. In the case where there is no equalizer in the storage device 5, the resource controller 4 acquires the equalizer module 222 by making a download request and stores it in the download buffer 203.

[0099]
In the case where modules necessary for the signal processing device 3 within the mobile wireless communication apparatus are not stored in the storage device 5, a download request will be made to a base station, in which a mobile wireless communication apparatus has designated the area the mobile wireless communication apparatus is located as a service area. The base station transfers the received download request to the network which is not shown in the diagram. The network transmits the requested modules via the base station to a mobile wireless communication apparatus, which issued a download request.

[0100]
Necessary signal processing functions are defined in the signal processing device 3 by shuffling the programs held in the storage area of the signal processing device. As a program, necessary modules are captured only when being required. This allows modules, which are usually unnecessary, to lower waste of resources, in other words,

wasteful occupancy of resources, caused by being stationed in the storage area of the processor. Therefore, providing an effective use of resources which are limited in capacity, the process can deal with roaming and hand-off between different wireless communication systems.

[0101]
More detailed operational examples of a mobile wireless communication apparatus complying with this embodiment of the present invention are explained blow. Firstly, explained below are cases involving changeovers in the communication types represented by a changeover from a state where a mobile wireless communication apparatus is used for voice calls into a state where that is used for data communication such as web browsing.

[0102]
In the case where the communication type is changed over from voice calls into data communication, modules for voice calls such as voice CODEC modules become unnecessary being replaced by new TCP/IP-mounted modules necessary for data communication. The resource manager 201 confirms whether any TCP/IP module exists in the storage device 5 by referring to the resource management table 200. If there is any TCP/IP module in the storage device 5, the module is read into the storage area of the processor as an execution file of a processor which serves as the signal processing device 3. Voice calls modules such as a voice CODEC module which have become unnecessary are cleared from the storage area of the aforementioned processor.

[0103]
The resource manager 201 obtains a TCP/IP module through the aforementioned downloading request, if there is no TCP/IP module in the storage device 5. The obtained TCP/IP module is written in the resource management table 200 after being stored in the storage device 5. The resource manager 201 then reconfirms whether any TCP/IP module exists in the storage device 5 using the resource

management table 200. The confirmed TCP/IP module is read in the storage area of the processor as an execution file. This provides the mobile wireless communication apparatus with data communication means.

[0104]
This operation is explained using Fig. 31 and Fig. 32. As described in Fig. 31, a voice receiving module 211 and a voice receiving module 212 are read into the storage area of the signal processing device 3 as in Fig 30. A data sending module 221, a data receiving module 225, a voice sending module 226 and a voice receiving module 227 are stored in the storage device 5.

[0105]
In S401, the first step of Fig. 32, the DSP 210 processes signals for voice calls by using both the voice sending module 211 and the voice receiving module 212. If a user of mobile wireless communication apparatus gives a command for shifting the data communication mode in such a state by operating an input/output device unit 7 shown in Fig. 1, a resource controller 4 makes a request for updating the resources in accordance with the command (Step S402). This allows the resource manager 201 located in the resource controller 4 to check whether or not there is any data communication module in the storage device 5 referring to the resource management table 200 (Step S403). While a download request is made when there is no data communication module in the storage device 5, the resource manager 201 notifies the DSP 210 of the start of rewriting when there is a data communication module (Step S404). This makes the DSP 210 suspend the execution of a module currently existing in its storage area.

[0106]
The resource controller 4 then makes a rewriting processor 202 delete a voice sending module and a voice receiving module both of which are currently existing in the storage area of the DSP 210, read in a data sending module and a data receiving module from the storage device 5 and rewrite them into the storage area of the DSP 210 (Step S405).

When the rewriting process of the rewriting processor 202 is completed, the resource controller 4 notifies the DSP 210 of the end of rewriting (Step S406). The DSP 210 performs a data sending module and a data receiving module in its storage area and processes signals for data communication (Step S407).

[0107]
Following the steps above, modules in the storage area (a memory resource in the DSP 210) are renewed under the control of the resource controller 4. This changes the signal processing function of DSP 210 from a voice calls function into a data communication function, and realizes the replacement of signal processing functions through the effective use of the limited storage area of the DSP 210. Therefore, the occupancy of memory resource by unnecessary modules is reduced.

[0108]
According to the example shown in Fig. 33, for example, instead of DSP, a programmable hardware device such as a PLD 230, which is rewritable in programmable manner, is used for the signal processing device 3. The PLD 230 operates with a module group 231 (e.g. modules A, B, C and D), and a module group 240 (e.g. module A, B, C, D, E, F...), which is intended to be used in the PLD 231, is stored in the storage device 5. The modules explained above are modules for circuit configuration program (circuit configuration description) such as a PLD layout/wiring diagram.

[0109]
The operation is explained below with the use of Fig. 34. First, the PLD 230 performs signal processing by using module A, B, C and D which is designed to establish a circuit configuration that performs signal processing for voice calls (Step S501). If a user wants to perform data communication in such a state, and gives a command for shifting data information by operating the input/output device unit 7 described in Fig 1, the resource controller 4 makes a resource updating request in accordance with the command (Step S502). It is assumed that modules B, C and D are modules for establishing circuit configuration

necessary for both voice calls and data communication.

[0110]
Since the data signifying that the modules B, C, D, and E are necessary for data communication is memorized in advance, the resource controller 4 is informed by checking the present module configuration in the PLD 230 that module A needs to be replaced by module E. The resource manager 201 of the resource controller 4 refers to the resource management table 200(Step S503), and checks whether or not there is a module E for establishing the circuit configuration that performs signal processing for data communication in the storage device 5 (Step S504)

[0111]
In the case where a module E is in the storage device 5, the resource manager 201 gives the rewriting processor 202 a command to rewrite the module A in a module group 231 which is retained in the PLD 230. Complying with this command, the rewriting processor 202 notifies the PLD 230 of the start of rewriting modules to (Step S505). This suspends an execution of processing in the circuit configuration comprised by the modules currently retained in the PLD 230. The rewriting processor 202 then aborts a module A retained in the PLD 230 and replaces it with a module A which was read out from the storage device 5 (Step S506).

[0112]
When the module rewriting processing of the PLD 230 is completed by the rewriting processor 202 following the steps above, the resource controller 4 notifies the PLD 230 of the end of rewriting to (Step S507). Responding to this notification, the PLD 230 establishes a circuit configuration by using a newly retained module group 231 (modules B, C, D and E) and performs signal processing of data communication by using the circuit configuration (Step S508).

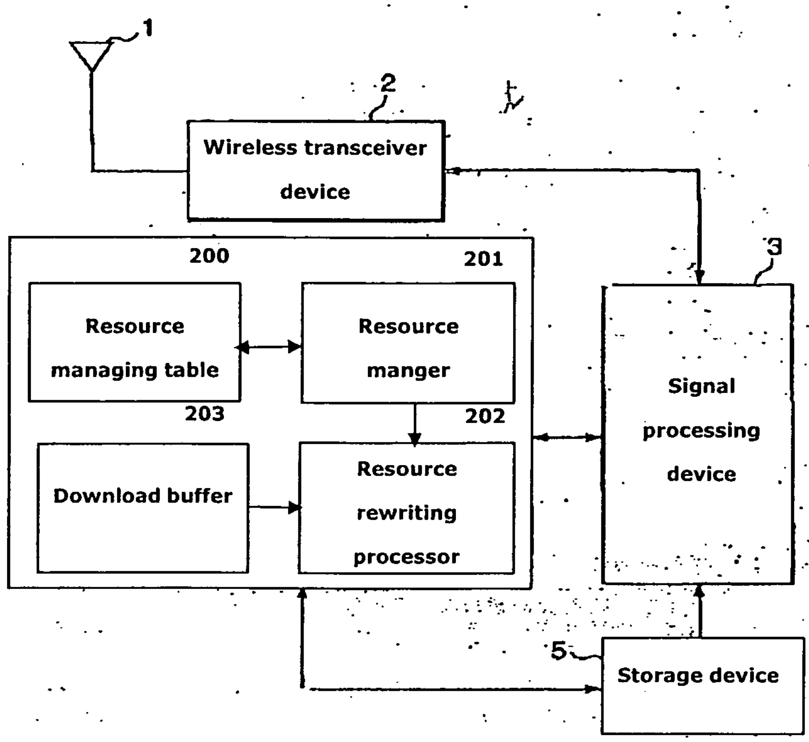
[0113]
However, in the case where there is no module E in the storage device

5 in the step S504, the resource controller 4 makes a download request (Step S509). Responding to this request, a module E is downloaded to be temporarily held in the download buffer 203. A star of rewriting is then notified to the PLD 230 in the step S505 (Step S505). In accordance with this notification, the module E held in the download buffer 203 is read by the rewriting processor 202, and is written into the PLD 230.

[0114]

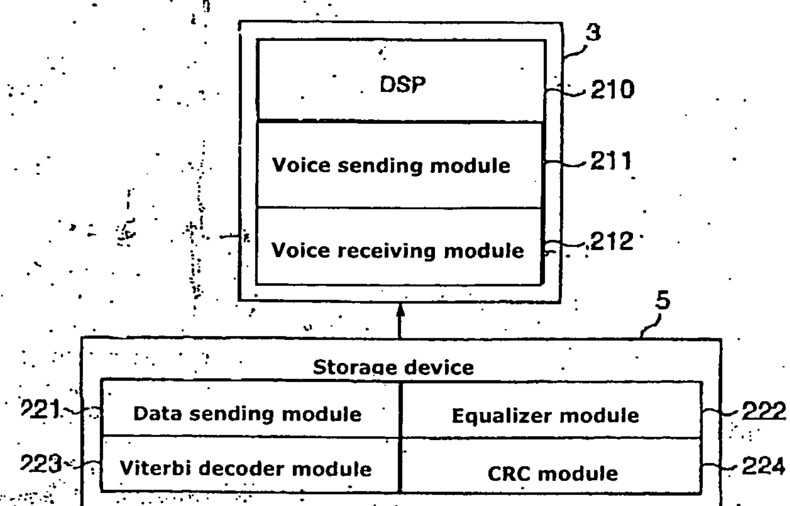
During this download process, or immediately after finishing it, the downloaded module E can be written into the PLD 230. This enables a quick shift from voice calls into data communication. Obtained modules through downloading are not only temporarily stored in the download buffer 203 but also saved in the storage device 5 as required, and applied to future applications.

[Fig.29]



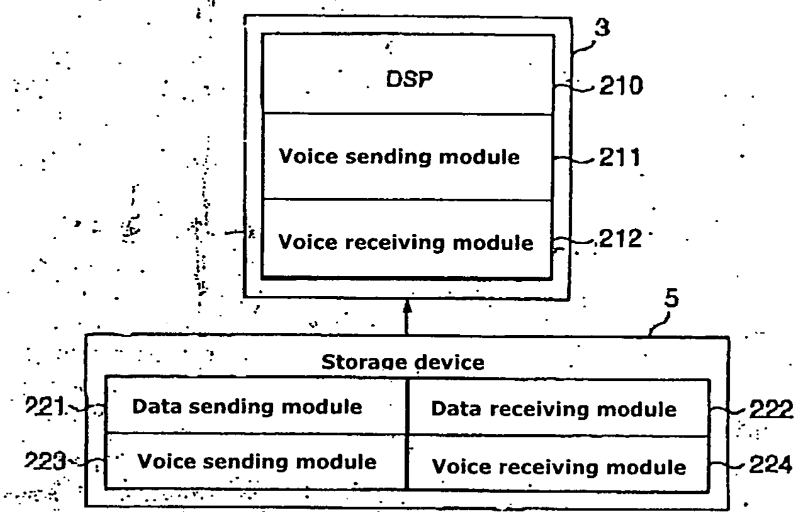
1
2
Wireless transceiver device
200
201
3
Resource managing table
Resource manger
203
202
Download buffer
Resource rewriting processor
Signal processing device
5
Storage device

[Fig.30]

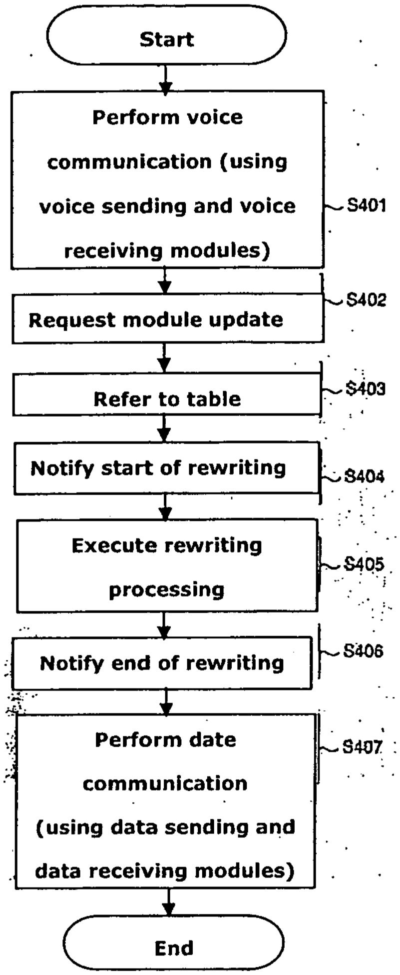


3
DSP
210
Voice sending module
211
Voice receiving module
212
5
Storage device
221
Data sending module
Equalizer module
222
223
Viterbi decoder module
CRC module
224

[Fig.31]

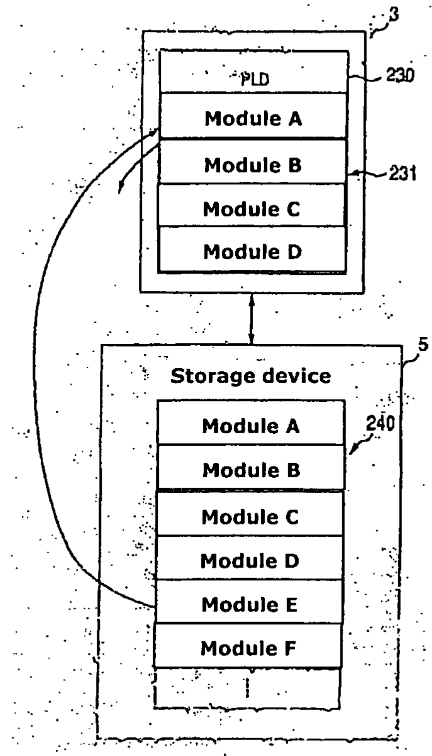

3
DSP
210
Voice sending module
211
Voice receiving module
212
5
Storage device
Data sending module
Data receiving module
221
222
Voice sending module
Voice receiving module
223
224

[Fig.32]



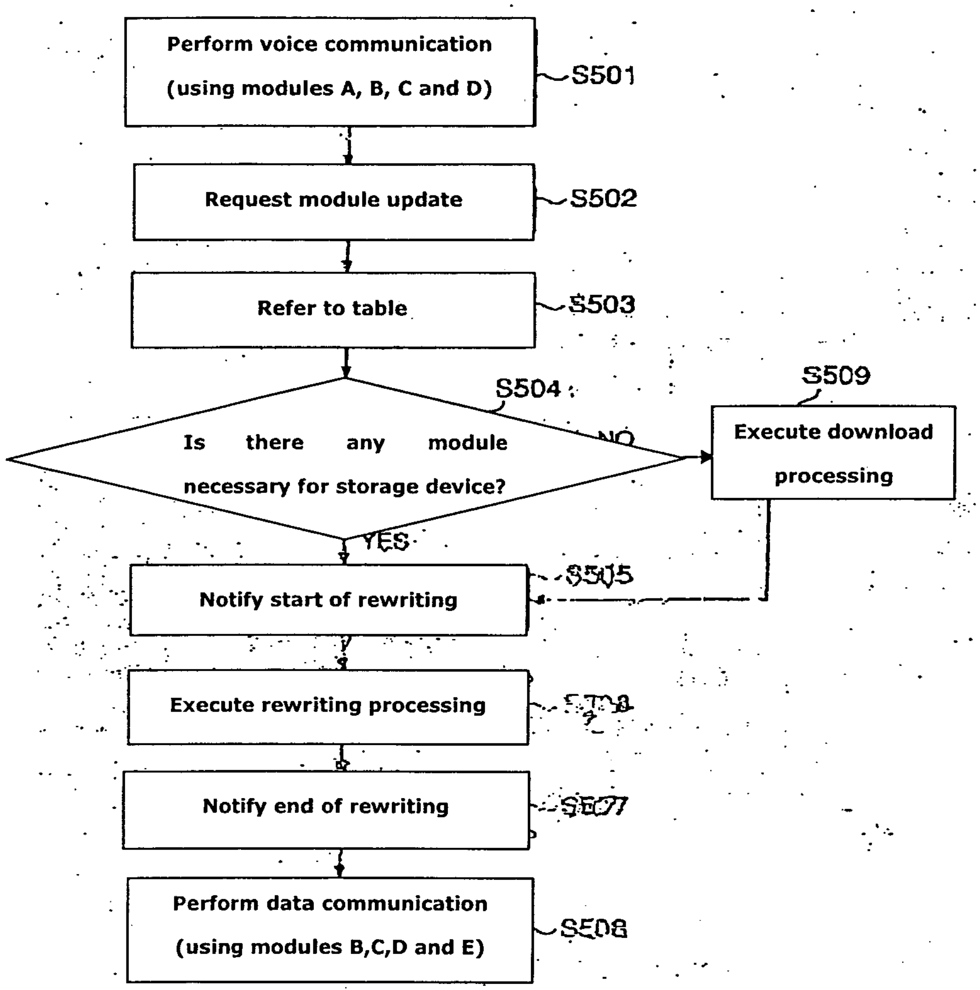
Start
Perform voice communication (using voice sending and voice receiving modules)
S401
Request module update
S402
Refer to table
S403
Notify start of rewriting
S404
Execute rewriting processing
S405
Notify end of rewriting
S406
Perform date communication (using data sending and data receiving modules)
S407
End

[Fig.33]



3
PLD
230
Module A
Module B
231
Module C
Module D
5
Storage device
Module A
240
Module B
Module C
Module D
Module E
Module F

[Fig.34]


Perform voice communication
(using modules A, B, C and D)
S501
Request module update
S502
Refer to table
S503
S504
Is there any module necessary for storage device?
NO
S509
Execute download processing
YES
Notify start of rewriting
S505
Execute rewriting processing
Notify end of rewriting
Perform data communication
(using modules B,C,D and E)